SCIENCE

VOL. 80 FRIDAY, OCTOBER 5, 1934 No. 2075

Scientific Ideals: DR. CHARLES L. REESE 299

Relationship of Veterinary Science to Animal Breeding and Public Health—Legal Protection of the Practise of Veterinary Science. II: DR. JOHN R. MOHLER 303

Scientific Events:
The Centenary of the Edinburgh Geological Society; The School of Forestry and Conservation at the University of Michigan; Reorganization of the U. S. Biological Survey; The Woods Hole Marine Biological Laboratory; Recent Deaths and Memorials 307

Scientific Notes and News 309

Discussion:
The Structure of the Chromosomes in the Salivary Glands of Drosophila: NIC. KOLTZOFF. *The Experimental Determination of Caste Differentiation in Termites:* DR. GORDON B. CASTLE. *Unsaturated Petroleum Oils as Insecticides:* DR. WALTER CARTER. *Plant Spacing, a Major Factor in the Local Adaptation of Strawberry Varieties:* DR. GEORGE M. DARROW. *The Rôle of Fungi in the Diet of Termites:* DR. ESTHER C. HENDEE 312

Scientific Apparatus and Laboratory Methods:
Physiological Media for Fresh-water and Marine Protozoa: DR. AMOS B. K. PENN. *Micro-Methods for the Detection of Proteases and Amylases:* DR. GRACE E. PICKFORD and DR. FRANCES DORRIS 316

Special Articles:
Observations on Functional Interrelationship between the Adrenal and Parathyroid Glands: PROFESSOR J. M. ROGOFF. *Histological Changes in the Bone Marrow of the Dog Following Amidopyrine Administration:* DR. D. K. MILLER. *Insecticidally Induced Immunity in Plants to Sucking Insects:* PROFESSOR DWIGHT M. DELONG. *Physical Relationships between Marsh Areas and Lake Levels:* G. L. LINCOLN 319

Science News 10

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

SCIENTIFIC IDEALS[1]

By Dr. CHARLES L. REESE

THIS is the occasion on which your president makes his formal adieu to the society, as a whole, and makes way for his successor, who, according to our custom, has already [illegible] and waiting his time to take up his duties.

It has been my good fortune to serve the society in many capacities, during the last forty years, of both major and minor importance, within and without the direct activities of the society.

The object of all scientific work is the search for truth, requiring honesty of purpose, the enlargement of human knowledge and service for the benefit of mankind. These ideals, when properly instilled into the student, by the teacher, usually have the effect of stimulating honesty of character, which, I am glad to say, is characteristic of all scientists in general.

The search for truth, through a period of years, fascinates the worker and he learns to love his subject, and consequently, he pursues it with ever increasing vigor.

Up to recent years, chemists, imbued with these ideals, preferred to enter the teaching profession, to secure the opportunity to continue fundamental research in the search for truth and the advancement of our science, to lead the ideal life, offered only by the academic atmosphere, and to follow a career of service, not only to science, but, to the rising generation, chemists, as well as man in general.

There is no more noble profession, in my mind, than that of a teacher, with its marvelous opportunities for character building and training the minds of the younger generation. But, in science, research must accompany teaching to prevent him from becoming a mere pedagogue—to keep his own mind from being reduced to that of a mere machine and from losing touch with the advance in his profession.

[1] Presidential address delivered before the meeting of the American Chemical Society, Cleveland, Ohio, September 10, 1934.

The teaching profession was, up to the establishment of organized research in industry, the only means of earning a livelihood open to the young doctor of philosophy to continue his studies and advancement in his profession. The limited field in our colleges and universities, where time and facilities were available to allow this professor to do research work, drove many chemical idealists either into secondary schools or isolated colleges, with no scientific colleague to consult, or stimulate his mind, and he led a life of isolation, which produced scientific dry-rot.

The only thing which saved such men was the semi-annual attendance at the meeting of such scientific societies as the American Association for the Advancement of Science, where they could make contact with men prominent in all fields of science, including his own profession, and then, later, the meetings of his own Chemical Society. He receives, even to-day, stimulation from the acquaintances made with the leaders in science, generally, in the former society, and his own science, in particular, in the latter.

Men located in such isolated or small institutions, in those days were said to be in "Pordunk" and they frequently occupied what were called "settees"—where they were required to teach, not only chemistry, but also other sciences, such as physics, mineralogy, geology, physiology or anything else. Is it any wonder that well-trained chemists, full of their ideals as scientists, hungry to do research work, were professionally without time to think? Thank God, I do not believe such conditions exist to-day, to any great extent. Is there any wonder that men imbued with true scientific spirit sought relief in industry or manufacturing pursuits?

To revert to the "science settee"—this is probably a relic of the early days, when scientists were not only chemists, but also physicists, geologists, mineralogists and in the early nineteenth century physicians as well, and the professors of science, in the best of our institutions, held such "settees."

Professor J. Norman Collie, in his lecture, "A Century of Chemistry at University College," made an interesting statement about Professor Thomas Graham, who succeeded Professor Turner in 1841 as the second professor in chemistry at University College in London and became later professor of practical chemistry. As an expression of Professor Graham's loyalty to his ideals, he says:

> The temptations of technical chemistry, by yielding to which, he would soon have secured a fortune, he disregarded. He dedicated his life to the nobler object of advancing the bounds of natural knowledge, and so, adding to those truths, which must ever remain for the good and the furtherance of humanity. He was one of the founders and first presidents of the Chemical Society of Great Britain, and was also the founder of the science of colloid chemistry.

In 1845, George Fownes became his colleague in practical chemistry. George Fownes's principal contribution was his "Manual of Chemistry," published in 1844, which went through eleven editions, and which is of interest to me, because this was my first [illegible] book in chemistry, under Dr. John W. Mallet, at the University of Virginia.

Mallet, the seventh president of our society and probably the only British subject to have held that office, was Irish by birth and was born in Dublin in 1832. He took his degree at Trinity College and his doctor's degree in Göttingen, under Wöhler in 1853. Coming to this country, that same year, at the age of twenty-one, he later became chief chemist for the Confederacy, and manufactured their gunpowder. He was famous as an analyst and for his determination of the atomic weight of gold. He was a gentleman and a chemist of the old school. He lectured on physics, as preparatory to chemistry, on organic and inorganic chemistry, and also gave a course of lectures on industrial chemistry, covering the reaction and machinery used in practically every industrial process, involving chemistry, known at the time, from heavy chemicals, metallurgy, alloys, down to beer, wine, glass and every known substance related to chemistry at that time, and even to bread-making. His lectures were illustrated not only from the finest collection of industrial products I have ever known, from all parts of the world, but he also had the most remarkable facility for making the most beautiful, accurate drawings of industrial equipment, in colored chalk, on the blackboard.

This, I believe, illustrates the character of practical chemistry which was taught primarily during the first three quarters of the nineteenth century.

Dr. Remsen, the first professor of chemistry in the Johns Hopkins University, well known to many of you, was thoroughly imbued with the ideals of promoting and teaching only pure science and would have nothing to do with the practical or industrial side of the profession. It was only with great difficulty that he was persuaded to allow a course of lectures to be given by one of his assistants on industrial chemistry, such as was given by Mallet and his British teachers. But, on one occasion, however, Dr. Remsen admitted that he had fallen from grace, by assisting a brewer, pointing out that his difficulty was due to polluted water. After his retirement, he became consultant for a great oil company.

I know, however, no professor of chemistry, in this country, who did more to inspire his pupils with scientific ideals, to promote fundamental research, or who trained more competent professors of chemistry,

be found to-day at the head of chemical departments of many of our universities and colleges. Many of the more recent graduates have, perhaps, fallen from grace and entered the industrial field, heading to-day industrial research, and even becoming executives, vice-presidents or presidents of industrial corporations.

Owing to easy profits made in the chemical industry, on up to the early eighties, there seemed to be no call for chemists, except for analytical work, but increasing competition and price-cutting made it necessary to find means to reduce costs, improve products and make new products, for the service of mankind.

These considerations caused certain industrial executives in 1900 to conceive the idea of establishing a central organized research chemical laboratory or department, with a dual purpose—one of studying existing processes, improving yields, and, thus preventing waste, to improve products in quality and cheapen them; the other to develop new and improved products, either in their own line or even to develop new industries. This broad program called for research of a high order and a considerable organization, which soon grew to be an important division of the concern. The wisdom of the step soon demonstrated the value of the idea. It resulted in much reduced costs to both producer and consumer, at the same time giving them many improved products. It has also, since that time, enabled them to branch into and establish many other industries of the greatest importance to our country, and led to the employment of thousands of men, not only wage-earners, but of scientists, engineers and office men.

It is interesting to note that the U. S. Bureau of Standards, well known to all of you, was established in 1901. It has grown into an institution of pure and fundamental research of the greatest importance to the country and its people, as well as to its industries. Here, not only official standards of weight and measure are established, but scientific standards as well as physical units. Through their large staff of trained scientists, many of them taught and trained within its own walls, it is called upon by all divisions of the government to make specifications for its purchases and tests, to see that the specifications are lived up to. Even states' and city governments call upon the bureau for work, without charge, but its activities have, of late, been curtailed, by the economies of the government, through loss of valuable and experienced personnel.

The U. S. Bureau of Standards may be classified as a publicly owned and great fundamental research laboratory, where all the physical sciences are represented, including chemistry, which has kept pace with industrial laboratories, and has been of great assistance to them.

The opening of the twentieth century may be considered as the date of birth of [illegible] in the growth and development of the chemical and allied industries of this country. This development put us into a position to meet the exigencies brought about by the world war. The growth and participation of industrial research organizations caused an increase in the number of students entering the profession and also stimulated increased activity in our colleges and universities.

This outbreak of the war and the depredations of submarine warfare, together with our entry into the war, created a tremendous demand for more and more well-trained chemists. The country can well be proud of the manner in which professors of chemistry, in our universities, stepped into the breach. They provided chemists for the industry, as well as by offering their own services to the government. In the Army and Navy, in the great laboratories created by the government, not only this, but the entire Chemical Warfare operation, including the great chemical manufacturing arsenal at Edgewood, headed by the late Colonel Walker, from the Massachusetts Institute of Technology, were manned by professors, students and industrial chemists and chemical engineers of the country. At the same time, it enabled us to establish the great industry that provided synthetic drugs and medicines, which, before the war, came mostly from Germany, to continue their supply of medicines, much needed, independent of foreign supply.

It also enabled us to establish a dye industry, which to-day supplies the country with a complete line of dyes, of all kinds, including the fast dyes. This accomplishment was brought about by American chemists thoroughly imbued with the ideals of science made possible through the seizure of German patents, by the enemy property custodian, Mr. Francis P. Garvan, lawyer, but one of the best layman friends the American chemist has had. Through his office, as president of the Chemical Foundation, by his determination to advance the sciences and the industry and stabilize it in our country, he is the greatest chemical idealist not a member of the profession.

The teaching and industrial leaders have always been in close touch in supplying and employing well-trained workers, and this close contact in war work brought them together, personally, as do the meetings of our great society, so that there is a close personal contact and friendship between most of them.

Many professors are employed as consultants by the research organization in industry, to the mutual benefit of both, in their own particular line of work and, I am sure, with no detriment to either. These

men and their coworkers are all actuated by the same ideals of the search for truth and honesty of purpose, for, after all, they are of the same breed. No scientist in industry could be of any other type, or he certainly would be a failure.

Some of our well-organized industrial laboratories are in a sense universities and trainers of men, and some of them maintain divisions devoted entirely to fundamental research for the advancement of human knowledge, in conjunction with their divisions for industrial and practical work, employing chemists, physicists, engineers and chemical engineers, patent lawyers, mechanics and laborers.

The following information is taken from the Bulletin of the National Research Council on Industrial Research Laboratories of the United States, as of January 1, 1933: There were 1,575 industrial and consulting laboratories against 1,625 reported in 1931. There are no personnel statistics in the fourth edition of 1931, but from the fifth edition of 1933 one can roughly calculate the personnel reported. These figures show 23,743 in 1933, with a loss of 12,847 from the 1931 figures, with a total of 36,590 in 1931.

In the publication of the National Research Council entitled "Profitable Practise in Industrial Research," Donald C. Jackson states:

> It is estimated that there are now (1932) in the neighborhood of thirty thousand research workers directly attached to technological problems, and that only about five hundred investigators are supported in the less restricted research of university laboratories and research foundations. The ratio is disquieting. Multiplication of the five hundred is a need. The fertility of industry is likely to wane unless new knowledge may continue forthcoming at a rate which is in suitable keeping with the rate of industrial application; and, unless new means for making the applications are constantly in review.

This was a revelation to me, if it is true, since I was of the impression that the figures were more nearly equal. When we consider the number of research fellowships and graduates doing research, working in our universities and colleges, and done under the supervision of our professors, the number of university workers must be larger. But Professor Jackson seems to forget the ever-increasing amount of scientific literature, from the entire world, evidenced by the growth of our chemical journals. Far from me to decry, however, the need of more work of this character, in our own country. But science is, fortunately, universal and up to date, it knows no bounds of nationality, its results are a free gift to humanity.

From the same book, to which I have already referred, Mr. William Spraragen, of the Research Council, in a chapter entitled "Trade Association Research," lists thirty-eight such associations, carr ing on industrial research and spending annu approximately, one and one half million dollars.

This work is being conducted in 24 of their o laboratories, in 24 universities and 22 governm laboratories, separately or in collaboration.

It will thus be seen that a large amount of ind trial research is actually being carried on in univ sity and government laboratories—seventy labo tories being involved in all.

This work is doubtless of value to the universi the professors as well as the associations. But, course, such results must be made public. It doub less broadens the professors' view-points and brin up countless fundamental problems, which should solved, to add to human knowledge. Such work done through fellowships, making it possible for universities to secure equipment, which they co otherwise not provide, and is also done at gover ment laboratories, by a system of research associa maintained by the industries.

Most of our institutes of technology also carry industrial research, mostly of a fundamental cha acter, and have accomplished much in improving a creating most efficient industrial chemical equipme They have aided industry to a remarkable degree such operations as distillation, filtration, grinding, a so forth, known as unit operations to the chemi engineer.

Practically all industrial research is founded up the vast amount of fundamental work accomplish by the hosts of professors, throughout the world, w have gone before and who have created our scienc as well as by those who are now with us.

Much honor to them, for man can but marvel at t progress of our sciences, during the past and sin the discovery of the common elements and the intr duction by Lavoisier of the quantitative factor, whi destroyed the alchemistic fallacy.

May I be pardoned if I mention some of those w were instrumental in bringing about the "New Er in the chemical and allied industries or who wer leaders in organized industrial research.

One spontaneously thinks of our beloved Wil R. Whitney, formerly president of our socie founder of and director for many years of the Ge eral Electric Company's research laboratory, Schenectady, and now one of their vice-president a man of high order of vision, but, coupled with much common sense; a true scientist, even carryi scientific methods into his hobbies.

I do not know the date of establishment, but it d not antedate the first decade of the twentieth centu by many years.

The accomplishments of this laboratory need

ments, as they are well known to most of you. interesting to know, however, that many of their t valuable accomplishments are due to men like gmuir and Coolidge, as a result of purely funda- tal research, men who, through their work, are wn and honored throughout the world.

Arthur D. Little, also one of our past presidents, done much to advance the chemical industry, with commercial industrial laboratory, where the work f the highest scientific order, actuated by all the ls of the search for truth. Any one visiting the eum in his laboratory can obtain some idea of t he has accomplished, even to the famous silk se, made from a sow's ear.

I will pass over the organized research departments the du Pont Company. It was, however, started the first year of the present century and its growth accomplishments stand for themselves, so I will e that for others to comment upon.

The Messrs. Mellon founded the Mellon Institute a rich endowment. Under the leadership of the sent director, Dr. Edward R. Weidlein, its success been phenomenal. It offers free space and ordi- y equipment to any industry wishing to take antage of its laboratory and organization, for the e salary of a fellow. It is a non-profit-making itution, but work accomplished there has created t least started on its way one of the largest and t successful chemical industries in the country many smaller ones.

I am sure that Dr. Weidlein's leadership and genial sonality has had much to do with the success of that institution. The new laboratory of the Mellon Institute, soon to be dedicated, is itself a noble monument to the donors and to industrial research.

It will be impossible to mention all, but such men as F. B. Jewett, organizer of what is, perhaps, the largest industrial laboratory in the world; the late Herbert Dow, who founded and built up a great industry based entirely on research; C. E. K. Mees, of the Eastman Kodak Company; E. C. Sullivan, of the Corning Glass Works, whose research products in glass are so important to the chemist and the cook; George D. McLaughlin, of leather fame; F. C. Kettering, of General Motors Corporation, and others, whom I would like to mention and praise, must be mentioned with the highest respect. Such men were called "industrial explorers" by Maurice Holland, in his work by that title.

Progress can not continue, in this material world of ours, any more than spiritual progress can be attained, without the eternal search for truth, constant endeavor to open the vistas of nature, through, not the work of the individual, but rather by the coordinated work and thought of many.

Love of the beautiful, in nature and art, the love of music, of thought expressed in art and architecture, or in literature and poetry, are the evidences of God in man, and so I feel that the man or woman who devotes his life to the search for truths in nature has the spirit of God in him. It is only by such spirit that we can possibly approach the laws of nature, which has brought order out of chaos in the universe, has made man and given him the power to think.

RELATIONSHIP OF VETERINARY SCIENCE TO ANIMAL BREEDING AND PUBLIC HEALTH—LEGAL PROTECTION OF THE PRACTISE OF VETERINARY SCIENCE.[1] II

By Dr. JOHN R. MOHLER

CHIEF, BUREAU OF ANIMAL INDUSTRY, U. S. DEPARTMENT OF AGRICULTURE

Legal Protection of the Practise of Veterinary Science

For the extension of its usefulness to humanity in ways, legal protection of the practise of veteri- y science is an important consideration. The vancement of veterinary science in the United tes has been measured in large degree by the pro- tion and encouragement afforded through enact- nt of laws relating to education, practise and civil vice.

Being a union of states, our governmental system vides for a distinct division of powers between the federal and state governments. There are, accordingly, certain laws applicable to the country at large and others which are limited in their operation to the confines of individual states. It is the function of our Congress and of state legislatures to enact laws, and while certain acts of our national Congress have been far-reaching in their influence upon the veterinary profession, due credit must be given to the various state legislatures for the helpful laws which they have enacted.

Laws Relating to the Public Service

The first legislation in the United States materially affecting veterinarians developed as the result of the existence of contagious pleuropneumonia of cattle.

[1] Address by the president of the Twelfth International Veterinary Congress, Waldorf-Astoria Hotel, New York, N. Y., August 13 to 18, 1934.

This disease, introduced in 1843 with cattle from Europe, had spread along the Atlantic seaboard. While various states had passed laws to deal with the situation, it became evident, if the disease was to be eradicated and our export trade in live stock preserved, that some action by the national government would be necessary. As a result, a law was passed in 1884, just 50 years ago, creating the Bureau of Animal Industry.

This law provided for the appointment of a chief of bureau. It specified that he should be a competent veterinarian. Qualified men were not numerous at that time, but a force was finally organized to cope with contagious pleuropneumonia. On this original force there were 18 veterinarians.

Meat-Inspection Laws

Reference has been made to federal meat inspection in another section of this discussion. Laws relating to the inspection of meats for interstate and foreign shipment, and of live cattle intended for export, were enacted by Congress in 1890 and 1891. These laws were superseded by the present law in 1906.

The effect of these various enactments was to create a further demand for qualified veterinarians, and the then existing small force in the Bureau of Animal Industry was augmented by the addition of men drawn from the practise of their profession.

Until 1894, the educational qualifications of applicants for veterinary positions in the federal service were not fixed. But in that year the appointment of these veterinary inspectors was made subject to Civil Service examination by law which prescribed those qualifications.

It may thus be said that laws administered by the Civil Service Commission have done much to elevate and advance the standards of veterinary education in the United States and, further, to safeguard the profession as a whole against the entry of an inadequately trained personnel.

State Veterinary Schools

The earliest known veterinary school was established in France in 1761. It was nearly 100 years later that the first school appeared in the United States. This is mentioned to emphasize the fact that our struggles here as a profession, from an educational standpoint, were a century behind those of our European colleagues.

Accordingly, some of the first veterinary inspectors in the government service were graduates of veterinary schools of Europe. Others were from the colleges of this country, as the latter began to spring up. These were then few in number. They afforded comparatively short and, for the most part, inadequate courses of study. Many communities were still dependent for veterinary service upon men who acquired their knowledge solely through practical experience and were without technical training.

The demand for qualified veterinarians in practise and in official positions inevitably became so urgent that the existing veterinary colleges could not supply the requisite number. To fill the growing need numerous private colleges came into existence with uniformity in standards and, in some instances, having a woeful lack of equipment and strongly commercial incentives.

It was at this time that, in various states, laws which became a potent force in correcting this situation were enacted. Veterinary schools were created in conjunction with state universities and agricultural colleges. A federal law now came into existence, providing for financial support of this movement.

It has been felt by some that the association of veterinary schools with agricultural colleges has tended to identify our profession with the science of agriculture when it should more properly be strictly allied with medical science. However this may be, these schools supported by public funds gradually supplanted the privately owned veterinary colleges. There are ten of these state institutions in the United States at the present time, with equipment, faculties and curricula affording a four years' or more intensive study course in veterinary medicine.

This also has tended to protect the field of veterinary science from a loss of prestige which might have resulted had it been necessary to depend upon privately owned schools for the education of veterinary students.

Army Veterinarians

A further aid to our profession has been the passage of laws relating to the establishment of a veterinary corps in the United States Army. Strangely enough, it was not until 1898 that a law was passed limiting candidates for the position of army veterinarians to those who were graduates of a recognized veterinary college, and requiring them to pass a satisfactory examination. The profession then waited more than 20 years for Congress to give adequate recognition to the veterinarian. In 1920 a law reorganizing the Army gave military status to the veterinary corps and provided for gradual promotion to a final rank of colonel.

The influence of this law has been far-reaching. It has done much to establish respect in this country for veterinary science.

Control over Biological Products

Another law which has been a great aid and protection to the practise of veterinary science in the United States is a national law enacted in 1913 for the purpose of controlling the importation and

facture, sale and interstate shipment of viruses, serums, toxins and like products intended for use in the treatment of domestic animals. Biological remedies, as heretofore discussed, when properly prepared are very useful in veterinary medicine. On the other hand, if lacking in potency or if contaminated they may cause great loss to the owner of treated animals and corresponding damage to the reputation of the attending veterinarian. Through regulations of the Secretary of Agriculture, based upon this law, veterinary practitioners are given assurance as to the potency and purity of any biological diagnostic agents and remedies which they may use.

As you well know, present-day means of communication and transportation have multiplied the dangers attending the uncontrolled exchange of viruses, cultures and specimens, not only between laboratories of the different countries, but between those within the same country. Therefore I am suggesting that the responsible directors of all laboratories take such measures as seem necessary to insure that these materials will not be exchanged without approval of the responsible official of the laboratory at the point of origin and the sanitary authorities of the nation or state to which they are consigned. This suggestion is directed especially to those doing research and experimental work with the hope that there will be full cooperation by all such workers to the end that disease may not be accidentally spread to states or localities where they do not now exist. All firms producing veterinary biological products in this country must hold a U. S. veterinary license and none legally may be imported unless the importer holds a U. S. veterinary permit. Rules and regulations have been promulgated for the guidance of domestic producers as well as for the guidance of those who desire to import veterinary biologics into the United States. I am particularly concerned, however, that such products may not be sent to this country from outside laboratories without permission in advance. This concern arises from the fact that not infrequently requests have been received to import materials carrying the causative agents of diseases which are nonexistent here and from the further fact that occasionally such materials have reached our shores without our prior knowledge. I am sure, therefore, that all will appreciate the mutual benefit to be derived from my recommendations.

FOOD AND DRUG ACT

In another portion of this discussion reference has been made to the supplementary informational service of the Food and Drug Administration.

During the past 40 years the United States has built up a series of laws, culminating in the Food and Drug Act of 1906, the purpose of which is to prevent injury to the public through the adulteration or misbranding of foods and drugs, or to prevent buyers from being misled as a result of false claims for a product.

Veterinary remedies are included under this present existing law and, as previously explained, the law is sufficiently broad to require the maintenance of certain standards of strength and purity in pharmaceutical products. Prior to its passage, owners of live stock in the United States had been more or less exploited by certain manufacturers of nostrums who made the most absurd claims for their products. It is no longer lawful, however, to make interstate shipments of drugs or mixtures of drugs labeled as remedies for diseases for which veterinary science recognizes no effective treatment.

Pharmaceutical products are subject to the provisions of this law, relating to accuracy in their compounding. Analysis is the only means by which variation of products from the standard can be determined. As a rule, practising veterinarians are not equipped to make such chemical examinations. Were it not for the control exercised by law in these instances, they would have no assurance that preparations used by them were of the potency indicated on the label. This law, therefore, not only has helped to eliminate in large measure a cheap form of competition which the practising veterinarian formerly met, but it has also given legal assurance to the veterinarian of general dependence upon the quality of pharmaceuticals used by the profession in practise.

THE INSECTICIDE ACT OF 1910

A law, somewhat similar in its purpose and operation to the Food and Drug Act, was enacted by Congress in 1910, relating to insecticides and fungicides. Under authority of this act, the Secretary of Agriculture prescribes regulations designed to prevent the interstate and export shipment of insecticides or fungicides that are adulterated or misbranded. Dips for live stock and also disinfectants as commonly used for premises which have become contaminated with some disease are included under this law.

Here again the veterinary practitioner is assured by law that he can have reasonable confidence in the stability of disinfectants which he may use or recommend for use by his clients, and in the reliability of preparations available in the market for the destruction of parasites, including lice, ticks and mange mites affecting animals.

STATE LAWS REGULATING THE PRACTISE OF VETERINARY MEDICINE

It is probable that of all laws affecting veterinary science in the United States, none have afforded more protection to the profession than those of the various states requiring a license to practise within the state. The District of Columbia and each of our 48 states have laws of this kind, regulating the practise of veterinary medicine. In most of the states those seeking to qualify as practitioners are required to pass an examination. In possibly six states, a diploma from an approved veterinary college is accepted in lieu of the examination. In 31 of the states applicants must be graduates of a veterinary school. In those states where this is not a requirement, the examinations are so rigid that few but college-trained participants can hope to pass the test.

During recent years the spread of veterinary information among live-stock owners throughout the whole country has been marked. This is also true of the rise of general public interest in the subject, especially those diseases communicable to the human family. Live-stock people and the general public, including the millions of owners of dogs and other pet animals, and our growing numbers of poultrymen, have materially increased their veterinary knowledge. They now expect much from our profession.

The standards established by these various federal and state laws, enacted within the last 50 years, have materially helped to confine the practise of veterinary science to men worthy of public confidence.

SUMMARY

Three subjects for many years have received the attention of the veterinary profession. Though seemingly diverse, these subjects—animal breeding, public health and legal protection of veterinary practise—are nevertheless closely related. In fact, they have their origin in a common root deeply embedded in the soil of tradition. They symbolize man's efforts to surmount the risks of his existence on this earth.

Through scientific skill and diligence, veterinary investigators have determined the causes of the principal animal maladies, and scientific literature has given their findings world-wide distribution. In the United States veterinary officials have established both regulatory and informational services in behalf of improved live-stock health. Regulatory measures include a wide range of inspection duties, in connection with the international and interstate movement of live stock, and systematic plans of disease eradication or control. The informational service acquaints owners and practitioners with official recommendations through publications, extension work, radio broadcasting, exhibits and motion pictures.

Quality in live stock is of profound veterinary interest, since animals that are valuable for breeding and utility purposes justify veterinary service more often than inferior types. Surveys have shown that stockmen interested in live stock improvement seek the latest facts concerning means of maintaining animals, including poultry, on a high plane of health and efficiency.

In the relation of veterinary science to public health, meat inspection is an effective barrier to the spread of live-stock infections to man. It also has valuable sanitary features. Veterinary supervision of animals, at time of slaughter, likewise is the basis for an extensive pharmaceutical industry which utilizes glands and other parts of animals for human ailments.

In cooperation with medical officers, veterinarians have aided in improving milk supplies through the establishment of sanitary standards, inspection and tests. These duties also commonly include supervision of general food supplies and of food-handling establishments.

The service of veterinary science to public health suggests other possible applications of knowledge, obtained from live stock, for the betterment of mankind. Promising fields are those of race improvement, nutrition and allied biological studies.

As a result of the unselfish and untiring efforts of those who were members of the profession in former times, and as an outcome of constantly widening public sentiment, with the support of intelligent and cooperative legislators, veterinary science has obtained legal protection comparable in every respect to that enjoyed by other professions in the United States.

The legal protection thus achieved has had an encouraging effect. With this security the profession as a whole has been imbued with higher purpose. It has contributed directly and forcefully to the extension of scientific usefulness in the community, the state and the nation. It has lifted the veterinarian into a vital and indispensable place in the economy of human affairs.

Indeed, legal protection to the practise of veterinary science is a recognized public necessity, in both a national and an international sense, for the reason that the proper distribution and application of veterinary knowledge are world needs.

With such legal protection, broadly speaking, veterinary science has been enabled to find expression through world organization, such as this gathering represents, and which, I trust, may contribute not only to a wider dissemination of veterinary knowledge but to a better understanding of means by which people of all nations may enjoy greater security, prosperity and happiness.

SCIENTIFIC EVENTS

THE CENTENARY OF THE EDINBURGH GEOLOGICAL SOCIETY[1]

THE centenary of the Edinburgh Geological Society was celebrated on Monday and Tuesday, September 3 and 4. A considerable number of invitations had been sent out to kindred societies and institutions both at home and abroad, and a most gratifying response was received. On Monday morning the delegates were received by the president of the society, Sir John Flett. Naturally the majority came from Scotland and England, but out of a total of sixty visitors, thirteen came from the Continent, nine represented the Colonial Empire and four the United States of America. Following this reception, the whole party, including many fellows of the society, had lunch in the city and proceeded to visit the Royal Scottish Museum, where the various exhibits were demonstrated by the museum staff. Afterwards a visit was paid to the offices of the Scottish branch of H. M. Geological Survey. Here all branches of the work were illustrated by carefully prepared exhibits including photographs, maps, rock collections and models. On Monday evening the fellows of the society and the delegates were received by the Lord Provost and Town Council of the city. Tuesday's program opened in the geology department of the university with a welcome by the principal, Sir Thomas Holland, who gave an address on the position of geology at the time the society was founded. This was followed by addresses by Professor F. D. Adams, of Montreal, who dealt with the beginnings of Canadian geological survey. Professor J. F. Kolderup, of Bergen, compared the geology of Norway with that of Scotland, and Professor Baron de Geer gave an interesting summary of the work on varve-clays and their possible use in correlating glacial deposits throughout the world. Professor W. N. Benson, of New Zealand, described the work of Sir James Hector, who was a graduate of the University of Edinburgh and a member of the society and initiated the geological survey of New Zealand. The afternoon was devoted to a tour of places of geological interest within the city. The celebrations were brought to a close on Tuesday evening when the society entertained its delegates to a dinner.

THE SCHOOL OF FORESTRY AND CONSERVATION AT THE UNIVERSITY OF MICHIGAN

THE regents of the University of Michigan at a recent meeting approved the action of the Faculty of the School of Forestry and Conservation whereby the following changes in existing programs of study and requirements for graduation were enacted:

That the school hereafter offer two main programs of study in Forest Production and in Wood Utilization. The first will aim to meet the needs of those who desire to go into some phase of forest protection, forest management or forest utilization, including wild life management and administration, or who desire a broad basic training in the various branches of forestry. The second will aim to meet the needs of those who are interested in obtaining a broad knowledge of the whole field of wood technology and wood utilization and who are looking forward to service as technicians, executives or administrators in one of the industries; and also of those who are particularly interested in some one industry or in some specific aspect of wood utilization, such as kiln drying, wood preservation or timber testing.

That admission to both programs of study come after two years of collegiate preparation, including certain specific subjects which will vary according to the student's field of interest. Under this arrangement those planning to enter the Forest Production program will normally take their preforestry work in the College of Literature, Science and the Arts; while those planning to enter the Wood Utilization program will normally take their preforestry work in the College of Engineering.

That the requirements for the degrees of Bachelor of Science in Forestry and Bachelor of Science in Forestry (Wood Utilization) include a minimum total credit of 128 semester hours of which approximately 47 hours must be in prescribed forestry subjects in the Forest Production program and approximately 40 hours in the Wood Utilization program.

That the requirements for the degrees of Master of Forestry and Master of Forestry (Wood Utilization) include a minimum total credit of 152 semester hours, of which approximately 60 hours must be in forestry subjects in the Forest Production program and approximately 52 hours in the Wood Utilization program. In both cases the forestry subjects must include those prescribed for the bachelor's degree and such others as may be specified by the faculty, together with at least six hours of problem work. The use of the degree of Master of Science in Forestry will be discontinued by the School of Forestry and Conservation, and the degree of Master of Science will be granted by the Graduate School to students who desire to emphasize forestry in their graduate work but who do not care to qualify for a professional degree.

The Honorable Charles W. Garfield, of Grand Rapids, has presented to the university, for the use of the School of Forestry and Conservation, a large amount of correspondence relating to the general development of forestry and conservation in the state, to the activities of the Forestry Commission (which was the predecessor of the Public Domain Commission and the present Department of Conservation), and to the establishment of the original Department of Forestry in the university.

[1] *Nature.*

REORGANIZATION OF THE U. S. BIOLOGICAL SURVEY

CONTINUING a reorganization of the Bureau of Biological Survey begun last July, J. N. Darling, chief of the survey, has recently consolidated the scientific agencies of the bureau into a new Division of Wild Life Research.

The realignment has been made, according to Mr. Darling, "to so adjust the faculties and talents existing in the bureau that the full force of our organization may be united in its efforts toward a balanced program of wild life conservation and public service."

Establishment of the division follows the setting up of a Division of Game Management and a Division of Public Relations and the reorganization of the Division of Administration.

The Bureau of Biological Survey is now organized in six divisions, as follows: Administration, Public Relations, Wild Life Research, Game Management, Land Acquisition, and Migratory Waterfowl Program, the last-named having been set up by Mr. Darling for the efficient expenditure of emergency funds in the Bureau's wild-life restoration program.

Dr. W. B. Bell, who has been in charge of the Division of Biological Investigations, has been placed at the head of the Division of Wild Life Research, which includes also the former Divisions of Food Habits Research, Fur Resources and Disease Control, now designated as sections of the research division. Work formerly carried on in the Division of Biological Investigations will later be organized in appropriate sections of the new unit, and a regional organization is being set up for carrying on field investigations and making contacts with universities, colleges and other scientific agencies. Ira N. Gabrielson, now director of the Division of Game Management of the Pacific Region, will at the close of the approaching hunting season be transferred to Washington as assistant administrator of the research division.

W. L. McAtee, for many years in charge of food-habits research, has been designated technical adviser and has been attached to the office of the chief of the bureau. Clarence Cottam, formerly assistant to Mr. McAtee, will be at the head of the Section of Food Habits Research in the new unit.

THE WOODS HOLE MARINE BIOLOGICAL LABORATORY

THE Deed of Trust Covering Fund for the Endowment of the Marine Biological Laboratory made in 1924 provides that once every ten years a Committee of Review shall make a study of the work of the Marine Biological Laboratory in order to determine whether the laboratory is performing valuable services in biological research and provides for the disposal of the fund in the event that their finding is in the negative. It is provided that this committee consist of nine members and include an official representative of each of the following: the National Academy of Sciences, the National Research Council, the American Association for the Advancement of Science, and six professors in the field of biology, named, respectively, by a majority of vote of the professors of the departments in the field of biology of the following universities: Harvard University, Columbia University, The University of Chicago, Princeton University, Yale University and the University of Pennsylvania.

The committee of review was constituted as follows:

Professor Edwin G. Conklin, representing Princeton University, *chairman;* Professor G. N. Calkins, representing Columbia University; Professor Wesley R. Coe, representing Yale University; Professor Frank R. Lillie, representing The University of Chicago; Professor T. H. Morgan, representing The American Association for the Advancement of Science; Professor Fernandus Payne, representing The National Research Council; Professor Charles R. Stockard, representing The National Academy of Sciences; Professor Rodney H. True, representing University of Pennsylvania, and Professor Alfred C. Redfield, representing Harvard University, *secretary.*

The first meeting of the committee was held at the Marine Biological Laboratory, Woods Hole, on July 21. The committee, having made a study of the work of the laboratory covering the past ten years, reached the following conclusions:

The organization of the laboratory, as embodied in its Constitution and By-Laws, continues to operate effectively under the control of professional biologists. The large number of investigators who have worked at the laboratory as shown by Exhibits III and V, drawn as they have been from more than four hundred institutions in this country and in many foreign lands, indicates the breadth of the laboratory's influence and services. The laboratory is especially well equipped for researches in general biology, experimental zoology and botany, embryology, physiology, biochemistry, biophysics and other branches of the biological sciences. Its research rooms, apparatus and facilities are excellent, and during the summer these are used to capacity. Living material for research is abundant and is promptly supplied by the Collecting (Supply) Department. The library is generally recognized as one of the best biological libraries in the country; and, as shown by Exhibit VII, has increased about threefold during the past decennium. It is freely accessible to investigators and is extensively used. General lectures and conferences are given at least twice a week throughout the summer session. They are largely attended and in general are very instructive and stimulating. One of the most important features of the laboratory is the close personal association of workers in many fields over considerable periods of time.

This is one of the chief attractions of the Marine Biological Laboratory.

The committee consequently voted unanimously that the Marine Biological Laboratory is performing valuable services in biological research.

RECENT DEATHS AND MEMORIALS

Professor William H. Echols, professor of mathematics at the University of Virginia since 1891, died at his home in his seventy-fifth year on September 25. Professor Echols was engaged in teaching until the time of his death.

Dr. Thomas Edward Satterthwaite, one of the founders and a former president of the American Therapeutic Society, a founder of the American College of Physicians, author of several medical treatises, died on September 19. He was ninety-one years old.

Dr. Freda Detmers, curator of the herbarium of the University of Southern California, formerly of the Ohio State University and its Experiment Station, died on September 5 at the age of sixty-eight years.

The eighty-sixth anniversary of the birth of Edward Livingston Trudeau will be observed at Saranac Lake, N. Y., on October 5, when officials of the State Committee on Tuberculosis and Public Health present to Trudeau Sanatorium a likeness of the little red cottage which he built in pioneering the outdoor type of sanatorium in America. The presentation will serve as a preview of the picture of the cottage which has been reproduced as the design of this year's health seals of the National Tuberculosis Association. The ceremony will take place in front of the cottage on Mount Pisgah where fifty years ago its building was begun. Those who are expected to be present include George J. Melbach, executive secretary of the committee, and members of his staff; Dr. Edward R. Baldwin, director of the Edward L. Trudeau Foundation; Dr. Fred H. Heise, medical director of Trudeau Sanatorium; Dr. John Steidl, Dr. Francis B. Trudeau, son of the founder of the sanatorium, and Ernest H. Wood, secretary of the Saranac Lake Society for the Control of Tuberculosis.

The Paris correspondent of the *Journal* of the American Medical Association writes that the monument erected to the memory of Dr. Roux in the gardens of the Hôpital des Enfants-malades was dedicated recently in connection with the holding of the international congress of French-speaking pediatricians in Paris. The monument consists of a large low relief, the work of the sculptor Rouche, which represents Roux in his laboratory examining a microscopic specimen. At the dedicatory ceremonies Dr. Martin, who was the collaborator of Roux at the Institut Pasteur in his discoveries of antidiphtheritic serotherapy, gave a biographic sketch interspersed with personal reminiscences, while Professor Marfan emphasized the importance of this discovery. The ceremonies were attended by many official delegates.

SCIENTIFIC NOTES AND NEWS

In honor of the eighty-fifth birthday of Dr. Ivan P. Pavlov, the Soviet Government has awarded to him an annual pension of 20,000 rubles and a fund of a million rubles has been made available for the enlargement of the physiological laboratories in Leningrad. In addition, five Pavlov scholarships of the value of 6,000 rubles each, to be awarded annually for physiological research, have been established. A complete edition of Dr. Pavlov's works will be published by the Soviet Academy of Sciences.

Sir Richard Glazebrook, director of the British National Physical Laboratory from 1897 to 1919, celebrated his eightieth birthday on September 18.

Yeshiva College will confer the degree of doctor of humane letters on Professor Albert Einstein, of the Institute for Advanced Studies at Princeton, N. J., at the opening exercises on October 8. Dr. Einstein will make an address. Other speakers will include Governor Lehman, Herman Bernstein, formerly United States Minister to Albania; Dr. David Eugene Smith, professor emeritus of mathematics, Columbia University, and member of the Yeshiva College Council, and Dr. B. Revel, president of the college.

Dr. J. R. Katz, of the University of Amsterdam, and Professor Farrington Daniels, of the University of Wisconsin, will be non-resident lecturers in chemistry during the coming year at Cornell University.

Dr. William Salant, director of the section on pharmacological research at the Biological Laboratory at Cold Spring Harbor, N. Y., has been elected guest professor of pharmacology at the New York Homeopathic Medical College and Flower Hospital.

Two hundred and seventy-five former students of Dr. R. C. Schiedt, professor emeritus of biology at Franklin and Marshall College, gave a dinner at Lancaster, Pa., in honor of his seventy-fifth birthday on September 21. The sum of five thousand dollars was raised toward the endowment of a fellowship, to be awarded to a graduate of the college for study in an American or foreign university. An edition of thirty etchings of Dr. Schiedt, by Walter Tittle, and a larger edition of photogravure reproductions were made for

distribution to the contributors to the fund. Professor W. A. Kepner, of the University of Virginia, was one of the speakers, and Professor A. A. Schaeffer, of Temple University, was chairman of the committee.

THE Society of Sigma Xi has announced a grant to Dr. H. R. DeSilva, professor of psychology at the Massachusetts State College, for work on the correlation of body voltage changes with basal metabolism by gasometric methods.

DR. HERBERT U. WILLIAMS, professor of pathology and bacteriology in the School of Medicine of the University of Buffalo, has retired after more than forty years of teaching.

S. C. HOLLISTER, professor of structural engineering at Purdue University, has been appointed director of the School of Civil Engineering at Cornell University.

DR. ARTHUR CHARLES BACHMEYER, since 1925 dean of the College of Medicine of the University of Cincinnati, has been appointed director of the University Clinics of the University of Chicago to succeed Dr. Henry S. Houghton, who has resigned to return to China as advisory representative of the China Medical Board, which owns and supports the Peiping Union Medical College. Dr. Houghton's resignation and the appointment of Dr. Bachmeyer become effective on January 1, 1935. Dr. Houghton, who was formerly dean of the Medical College of the University of Iowa, has been director of the clinics and associate dean of the Division of Biological Sciences since 1933.

PROFESSOR E. R. MCKEE, formerly associate professor of electrical engineering at the Iowa State College, will succeed the late Professor L. P. Dickinson as head of the department of electrical engineering of the University of Vermont.

DR. PAUL HEMKE has been appointed professor and head of the department of aeronautical engineering at the Rensselaer Polytechnic Institute, the appointment to take effect in September, 1935. Dr. Hemke has been professor of aeronautics and mathematics at the U. S. Naval Academy and at the Case School of Applied Science.

AT the Ohio State University, Dr. Carl L. Spohr has been made acting chairman of the department of pathology, succeeding the late Dr. Ernest Scott.

ERNEST P. GOODRICH, formerly Commissioner of Sanitation of New York City, has been appointed director of the new public works and construction courses in the New York University College of Engineering. Mr. Goodrich will supervise a group of five courses planned and arranged by Professor Thorndike Saville, who has been granted leave of absence to direct a national survey of water resources for the U. S. Department of the Interior.

DR. FRANK M. SCHERTZ, formerly of the Fixed Nitrogen Research Laboratory of the U. S. Department of Agriculture, known for his investigations on the chloroplast pigments and particularly chlorophyll, has been appointed director of research of The American Chlorophyll Company, of Washington, D. C.

DR. B. E. DAHLGREN has been appointed curator of the department of botany, and Henry W. Nichols curator of the department of geology at the Field Museum of Natural History. Dr. Dahlgren has been a member of the botanical staff of the museum since 1909. Mr. Nichols joined the staff in 1894, and was associate curator of geology for many years. Since the death in November, 1933, of Dr. Oliver C. Farrington Mr. Nichols has been acting curator of the department.

DR. PAUL F. RUSSELL, of the International Health Division of the Rockefeller Foundation, has been detailed for malaria research at the All-India Institute of Hygiene and Public Health, Calcutta. For nearly five years Dr. Russell has been in charge of malaria investigations, at the Bureau of Science, Manila, P. I.

JOHN B. WHITNEY, who spent two years in the Soviet Union in a consulting capacity, has been invited by the Soviet Government to return, and sailed early in September to make his headquarters in Moscow.

FRANK ADAMS, professor of irrigation investigations and practise at the College of Agriculture of the University of California, who has been given leave of absence from August 1, 1934, to January 31, 1935, is in Washington, to work out for the Reclamation Service a policy for irrigation development. He will prepare a report for Dr. Elwood Mead, Commissioner of Reclamation, U. S. Department of the Interior.

DR. ALEXIS CARREL, of the Rockefeller Institute for Medical Research, returned from France on September 25.

DR. FRANK D. KERN, head of the department of botany at the Pennsylvania State College and dean of the Graduate School, has returned after a year's leave of absence during which he served as acting dean of the College of Agriculture of the University of Puerto Rico. He is succeeded by Professor Harry G. Parkinson, head of the department of agricultural education at the State College.

DR. TRACY I. STORER, professor of zoology at the Davis Branch of the College of Agriculture of the University of California, has returned from a trip to Europe where he went to study methods used in eco-

nomic vertebrate zoology. Dr. Storer was absent during the spring semester on Sabbatical leave.

DR. REXFORD G. TUGWELL, Under Secretary of Agriculture, will speak on October 22 at the opening in Rome of the International Institute of Agriculture, to which he is a delegate.

DR. A. R. MOORE, professor of general physiology at the University of Oregon, who has recently returned from Sendai, Japan, where he was Rockefeller visiting professor of physiology, will deliver a series of lectures from October 15 to 20 at the College of Medicine of the University of Illinois, under the auspices of the Graduate School. The lectures will be on "The Physiological Basis of Individuality in the Early Embryo and in Elementary Forms."

LAST year the Rensselaer Chapter of Sigma Xi sponsored a series of six lectures, open to the public, and given by authorities in various fields, the average attendance at which was approximately four hundred, including members and their guests. The chapter has arranged a similar series of lectures for the coming year, and the following have expressed their willingness to speak: Dr. Wilder D. Bancroft, Cornell University; Dr. Harold C. Urey, Columbia University; Dr. Matthew Luckiesh, director of the Nela Laboratories, Cleveland; Dr. Edgar Allen, Yale University; Dr. Harold Larrabee, Union College, N. Y., and Dr. Benjamin Boss, director of the Dudley Observatory, Albany, N. Y. Others have accepted tentatively if satisfactory dates can be arranged. The first lecture of the series will be given on Friday evening, October 19, by Dr. Bancroft. His subject will be "Alcoholism, Morphinism and Insomnia."

THE Electrochemical Society held its annual meeting in New York City on September 28 under the presidency of Professor Hiram S. Lukens, head of the department of chemistry of the University of Pennsylvania. The speakers at the dinner included S. G. Hibben, of the Westinghouse Lamp Company; Dr. Colin G. Fink, of Columbia University, and James H. Critchett, of the Union Carbide and Carbon Corporation.

A NATIONAL Association of Science Writers has been founded, the active membership of which is limited to staff members of newspapers and press associations that devote their major efforts to the field of science. Charter members are Howard Blakeslee, science editor of the Associated Press; Ferry B. Colton, assistant science editor of the Associated Press; Watson Davis, director of Science Service; David Dietz, science editor of the Scripps-Howard newspapers; Victor Henderson, of the *Philadelphia Inquirer;* Thomas R. Henry, of the *Washington Star;* Waldemar Kaempffert, science editor of *The New York Times;* Gobind Behari Lal, science editor of the Hearst Newspapers; William L. Laurence, science news editor of *The New York Times;* John J. O'Neill, science editor of *The New York Herald-Tribune;* Robert D. Potter, staff writer in physics and chemistry, Science Service. Mr. Dietz has been elected president of the association. One honorary member has been elected, Austin H. Clark, of the Smithsonian Institution. Mr. Clark is press director of the American Association for the Advancement of Science. The purpose of the National Association of Science Writers, as set forth in its constitution, is "to foster the dissemination of accurate scientific knowledge by the press of the nation in cooperation with scientific organizations and individual scientists."

MEMBERS of the Northeastern Section of the American Society of Agricultural Engineers will hold a joint meeting with the New England Rural Electrification Institute at Massachusetts State College, on October 17, 18 and 19. The program will cover a wide field of subject matter including a report of government surveys on the housing need on farms, drainage with dynamite, and the use of light traps in the orchards for controlling pests. A new type of sterilizer for the farm dairy will be demonstrated and new developments in electric brooding will be reported. On Thursday afternoon Dr. Hugh P. Baker, president of the college, will extend a welcome to the visitors. E. H. Thompson, president of the Federal Land Bank of Springfield, will discuss "Agricultural Credit," and Frederick M. Feiker, secretary of the American Engineering Council, will speak of "The Responsibility of the Engineer in the Present National Emergency."

THE *Journal* of the American Medical Association reports that plans for the second International Neurologic Congress, to be held in London from July 29 to August 2, 1935, have been announced by the committee for the United States, of which Dr. Bernard Sachs, New York, is chairman and Dr. Henry Alsop Riley, New York, secretary. Four topics have been chosen for consideration: the epilepsies, physiology and pathology of the cerebrospinal fluid, functions of the frontal lobe, and the hypothalamus and the cerebral representation of the autonomic system. These subjects will be presented at morning sessions, and afternoon sessions will be devoted to discussion of miscellaneous topics. Any recognized neurologist or psychiatrist may submit titles for presentation at the miscellaneous sessions. Such titles, accompanied by brief abstracts, must be submitted to the United States committee before January 15, 1935, in English, French or German. Those accepted will be forwarded to the secretary general in London for final consideration. The maximum time for presenta-

tion will be ten minutes. Candidates for membership may apply either through the national committee or through the secretary general of the congress, Dr. S. A. Kinnier Wilson, 14 Harley Street, London. Thomas Cook and Son are official travel agents for the congress, and arrangements for traveling and hotel accommodations may be made through them. Requests for application blanks and the submission of titles should be made as soon as practicable. In addition to Dr. Sachs and Dr. Riley, members of the committee are Drs. Harvey Cushing, Yale University Medical School; Charles L. Dana, Woodstock, Vt.; Adolf Meyer, Baltimore, and Frederick Tilney, New York. Dr. Riley's address is 117 East Seventy-Second Street, New York.

THE New York Homeopathic Medical College and Flower Hospital is entering upon its seventy-fifth year since the charter was granted in 1860. The Board of Trustees has designated June, 1935, as the time for formal celebration of the anniversary. Professor Lindsley F. Cocheu has been appointed chairman of the Committee on Arrangements.

THE School of Medicine, George Washington University, of which Dr. E. B. McKinley is dean, celebrated the opening of the one hundred and tenth academic year on September 19 in Washington, D. C. Addresses were delivered by President Cloyd Heck Marvin, of the university, and Dr. William J. Mallory, professor of medicine. Among the visitors and guests present were Professor John Reenstierna, of the department of bacteriology of the University of Upsala, Sweden; Captain Harold Smith, commandant, U. S. Navy Medical School, and Colonel P. W. Huntington, commandant, U. S. Army Medical School.

AN affiliation has been effected between the New York Post-Graduate Medical School and Hospital of Columbia University and the Stuyvesant Square Hospital, formerly known as the New York Skin and Cancer Hospital. According to the terms of the agreement, which went into effect on September 1, the Stuyvesant Square Hospital maintains its identity. Both the Stuyvesant Square and the Post-Graduate Hospitals were founded in the same year—1882—and are pioneers in their respective fields.

Nature states that the report of the Council of the British Association, adopted by the General Committee at Aberdeen on September 5, records that the local committee for the Leicester meeting has presented the sum of £1,000 to the association, being the unexpended balance of the fund raised locally for the purposes of the meeting. This gift has been accepted, and the sum will be invested to form a Leicester and Leicestershire Fund, the interest of which will be used "to assist by scholarship or otherwise a student or students working for the advancement of science."

THE Alpha Chi Sigma banquet was held in conjunction with the national meeting of the American Chemical Society at Cleveland on September 11. Two hundred and forty men were present, representing 39 chapters. Mr. John E. Schunck, of the Ohio Carbon Company, Cleveland, Ohio, served as toastmaster. Other speakers were: Dr. L. V. Redman, past president of the American Chemical Society and president of the Bakelite Corporation; Dr. Charles A. Mann (a past president of the fraternity), head of the department of chemical engineering, University of Minnesota; Dr. Wm. R. Veazey, director, department of chemistry, Case School of Applied Science; Dr. H. E. Howe, editor of *Industrial and Engineering Chemistry*, and H. E. Wiedemann, executive head of the fraternity and consulting chemist of St. Louis. A guest of honor was Dr. L. F. Work, president of the Phi Lambda Upsilon Fraternity. Souvenirs furnished by the Ohio Carbon Company were given in the form of a "Cleanaire," a device for keeping air in refrigerators pure and wholesome. Dr. W. A. Noyes, Sr., professor emeritus, University of Illinois, held the lucky number and was awarded a set of gold-plated analytical weights donated by the J. T. Baker Company. Thirty-five other prizes were furnished by the Aluminum Company of America, The Chemical Rubber Company, The Central Scientific Supply Company, Handbook Publishers, Inc., and the Bakelite Corporation. The banquet was arranged by the Cleveland professional group of the fraternity under direction of Dr. I. W. Brandel, of the Ohio Carbon Company, and W. K. Lonsdale, of the James Herron Company, Cleveland. Cooperation on the part of committeemen of the American Chemical Society convention contributed to the success of the evening.

DISCUSSION

THE STRUCTURE OF THE CHROMOSOMES IN THE SALIVARY GLANDS OF DROSOPHILA

THE recent discovery of Professor T. S. Painter[1] has attracted the attention of geneticists throughout the world. In all genetical laboratories the structure of the chromosomes in the salivary glands of Drosophila of different genotypes, having inversions, deficiencies, translocations, etc., is being studied, and the cytological picture is being compared with the genetical chromosome-map. I have seen hundreds of preparations of salivary glands of different Diptera,

[1] SCIENCE, 78: 2034, 585, December 22, 1933.

made in the genetical and cytological departments of my Institute of Experimental Biology. Professor H. J. Muller, of the University of Texas, has also demonstrated to me a series of very good preparations of Drosophila having various abnormalities in the X-chromosome, made in the Institute of Genetics of the Academy of Sciences in Leningrad.

I do not wish here to advance an opinion about the genetical correspondence between the segments of the chromosomes in the salivary glands and the definite loci in the genetical map of Drosophila. The general scheme of this has been given by T. S. Painter and the details are being worked out by him and other geneticists. But the question concerning the origin of such extraordinary structures as the enormous chromosomes in the cells of the salivary glands of insects is also of general interest.

In every microscopic section through larvae of Drosophila, nuclei of different sizes are to be seen; some of them are many times larger than others. In liver cells of mammals Jakoby[2] has found that the sizes of different nuclei increase in a constant ratio, 1:2, 4:8, etc.; he comes to the conclusion that something in these nuclei has been divided into two parts 1, 2, 3 or 4, etc., times. From the work of S. L. Frolova[3] we know that the large size of the nuclei of tracheal cells depends on their tetraploidy, and in rectal glands very large nuclei are octoploid. The nuclei of salivary glands have the same diploid number of chromosomes as normal somatic cells, but these chromosomes are enormous. What nuclear structures are multiplied in the development of these chromosomes?

I think that the size of the chromosomes in the salivary glands is determined through the multiplication of *genonemes*. By this term I designate the axial thread of the chromosome, in which the geneticists locate the linear combination of genes; the cytologists call it generally the "axoneme" or "chromonema." In stained preparations the genoneme remains almost colorless, but at certain points small masses of chromatin—the chromomeres—are attached to it. In the normal chromosome there is usually only one genoneme; before cell-division this genoneme has become divided into two threads. I postulate that in the cells of the salivary gland, which have lost the ability of reproduction by mitosis, the genonemes have become divided four times, whereas the chromosome has remained undivided but has grown correspondingly.

Fig. 1 represents the scheme of such a chromosome in Diptera: 16 genonemes are to be seen in the chromoplasma: they are well distinguishable in Chironomus and proceed in parallel spirals near the surface

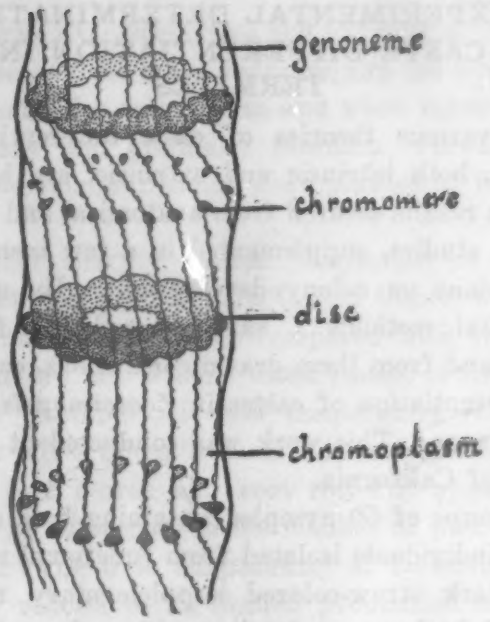

FIG. 1.

of the chromosome. At intervals of unequal size they carry deeply stained chromomeres, which are sometimes very small granules, sometimes large and united into transverse disks. In many cases it is easy to count the number of small chromomeres not only in stained preparations but even in living cells of Chironomus and in microphotographs of living cells. As the disks usually remain at right angles to the optical axis, only half of the chromomeres, *i.e.*, 8–9, are seen in the photo. The number of genonemes in the chromosomes of Chironomus corresponds strictly to the number of chromomeres; in Drosophila the genonemes are less distinct, but the number of chromomeres is the same. The genonemes and the chromomeres lie in the *chromoplasm*.

The nuclei of some other glandular cells in Diptera (intestinal tract and others) have the same structure, but the number of genonemes in their chromosomes is perhaps smaller.

It is difficult to decide what structure corresponds to the gene—the chromomere or the piece of genoneme between two chromomeres. The latter assumption seems to me more probable. The most recent discoveries of Heitz[4] prove that in the chromosomes of Drosophila the inactive parts are stained more strongly, in contrast to the active parts, and we may therefore suppose that the chromatin granules and the "disks" are only joints between the genes, and the points where the crossing-over takes place. But this is only a hypothesis, developed on the basis of my other hypothesis concerning the molecular structure of chromosomes, published in 1927.[5]

NIC. KOLTZOFF
INSTITUTE OF EXPERIMENTAL BIOLOGY
MOSCOW

[2] *Arch. Entw. Mech.*, Bd. 106, S. 124, 1925.
[3] *Ztschr. f. Zellf. u. mikr. Anat.*, Bd. 3, H. 3, 1926.
[4] *Ibid.*, Bd. 2, H. 1–2, S. 237, 1933.
[5] *Biol. Zentrbl.*, Bd. 48, H. 6, 1928.

THE EXPERIMENTAL DETERMINATION OF CASTE DIFFERENTIATION IN TERMITES

THE various theories of caste differentiation in termites, both intrinsic and extrinsic, are based entirely on results secured from anatomical and morphometrical studies, supplemented in a few instances by observations on colony development. By using experimental methods I have secured the following results, and from them drawn conclusions, concerning the differentiation of castes in *Zootermopsis angusticollis* Hagen. This work was conducted at the University of California.

In groups of 50 nymphs containing both male and female individuals isolated from functional reproductives, dark straw-colored supplementary reproductives of both sexes develop within from 35 to 50 days after isolation. These supplementary reproductives ordinarily develop from nymphs in the fifth and sixth instars, occasionally from individuals in the fourth or seventh instar. They may be apterous or may bear wing pads which range in size from mere flanges to pads comparable in size to those of the seventh instar nymph approaching alation.

In the presence of one functional reproductive of either sex in such isolated groups no supplmentary reproductives of that sex develop and, conversely, in the absence of a functional reproductive of either sex in such isolated groups supplementary reproductives of that sex develop.

Nymphs of the fifth and sixth instar isolated singly for 45 days exhibited reproductive potentialities, as shown by the increase in the size of the eggs in the ovaries of the females and by the fact that when a male and female previously isolated were later mated they produced eggs from 30 to 35 days sooner than pairs of nymphs which had remained in the presence of functional reproductives prior to mating.

By feeding alcohol or ether extracts of the bodies of functional queens to groups of nymphs in the fifth and sixth instars it was possible to increase materially the time required for the development of female supplementary reproductives in groups isolated from functional reproductives. The time required for the development of male supplementary reproductives from nymphs thus fed in these groups was, however, not at all delayed.

It is evident in the light of these results that differential feeding (*i.e.*, the feeding of a special diet to certain nymphs such as oral or anal contributions from other members of the group) is inadequate to explain the production of supplementary reproductives. Likewise, it is exceedingly improbable that supplementary reproductives are genetically determined as such. The results are, however, in accord with the inhibition theory, put forward by Pickens,[1] which holds that functional reproductives of each sex produce respectively a substance which, when eaten by the nymphs of a group, inhibits the development of the reproductive organs in the nymphs of that sex. This material is thought to be distributed normally throughout the group by grooming.

The results indicate that all members of the colony, except the true pseudo-soldier nymph and the true adult soldier, are potentially reproductive and, with the exception of the wing-padded nymph of the late seventh instar and the first form reproductive, can develop into supplementary reproductives in the proper environment. Supplementary reproductives are examples of neoteny.

In incipient colonies of *Z. angusticollis* only one soldier develops during the first year of colony life. This soldier is always present in the colony within 75 days after the first egg hatches and is always in the fifth instar. By removing the first and successively produced soldiers from such an incipient group it has been possible to secure as many as six such soldiers from one colony during the first year. In incipient colonies to which soldiers were added before the appearance of the first pseudo-soldier nymph no soldiers developed. The presence of older nymphs, added to incipient colonies at the time of establishment, retarded the progression of nymphs through the first four instars and either delayed or inhibited the development of soldiers during the first year.

These results point clearly to the fact that the assumption of the soldier form by one nymph in an incipient colony is closely associated with the relationships which exist between the members of the group. Too much emphasis can not be placed on the importance of recognizing the integrity of a termite community. By removing a certain single individual from the group the balance of the colony may be so disturbed as to result in a change of the normal development of members of the group. Likewise, the addition of a certain single individual at certain stages of development of the colony may alter this balance to such an extent that the course of development of certain individuals may be delayed or even entirely prevented. Such vital modifications of individual development resulting from such slight changes in colony composition illustrate the importance of individual interrelationships in maintaining the delicately balanced unity of a termite community.

GORDON B. CASTLE

UNIVERSITY OF MONTANA
MISSOULA

[1] A. L. Pickens, *Pan-Pacific Ent.*, 8: 178–180, 1932.

UNSATURATED PETROLEUM OILS AS INSECTICIDES[1]

SATURATED petroleum oils have shown an increasing use as insecticides for several years, owing to their generally satisfactory performance, to the absence of suitable substitutes and to the belief that saturation (*i.e.*, removal of most of the unsaturated hydrocarbons) was essential to the safe use of the oils on tender plants.

Recent studies by the writer have indicated that radical departures from the standard practise may be possible with the result that the use of an easily available and low-priced class of oils will become feasible.

Diesel fuel oils, at present used freely in the Hawaiian Islands as weed killers, have proved effective insecticides and their toxic effects on plants have been practically completely mitigated.

Briefly, the oils are emulsified on a colloidal clay carrier such as Bentonite. They are then diluted in the spray tank in such a manner that the hydration of the oil-charged Bentonite particles is greatly increased and, conversely, the toxic effects of the oils on plants eliminated. This process, which in practise is extremely simple, is essentially one of acidifying the spray water prior to adding the concentrated emulsion.

Field tests have shown that a 1 per cent. dilution of a concentrated emulsion containing 50 per cent. Diesel oil is adequate for control of the pineapple mealy bug (*Pseudococcus brevipes* Ckl.), on pineapple and repeated sprays of from 1 per cent. to 4 per cent. have shown no phytocidal action. Preliminary experiments on citrus have given excellent control of green scale (*Coccus viridis* Gn.) when a 3 per cent. dilution was used and no deleterious effects on the plants have been noted.

Details of these studies will be presented in full later.

WALTER CARTER

UNIVERSITY OF HAWAII

PLANT SPACING, A MAJOR FACTOR IN THE LOCAL ADAPTATION OF STRAWBERRY VARIETIES

STUDIES[1] of the responses of the strawberry plant to various factors have indicated that photoperiodism, temperature and duration of the rest period determine the general adaptation of varieties in the humid regions of the United States. The commercial varieties of the South grow vigorously during the short days of early spring and when planted in the North become over-vegetative and unfruitful. Northern varieties, on the other hand, require the long days of midsummer for full growth and when taken South grow weakly and gradually succumb. Howard 17, for example, finally died out when planted at Willard, N. C.

The rather sharply limited adaptation of strawberry varieties of northeastern United States, with the exception of Howard 17, as compared with varieties of the southern and Pacific coast states, is traceable in part to photoperiodic and temperature reactions and to the effect of environment on susceptibility to leaf spot, leaf scorch and root rot, but apparently even more to differences in the number of plants in a given area. The wide adaptability of Howard 17 is apparently related to its limited production of runner plants, which, in Maryland at least, are not generally initiated after August 15.

Careful observations during the current season of the new varieties, Dorsett and Fairfax, and the older variety, Blakemore, all introductions of the U. S. Department of Agriculture, support the explanation that spacing is the chief factor in the local adaptation of strawberry varieties. At Willard, N. C., the yields of Blakemore plants grown under various spacing systems, ranging from an average of over 30 plants to only two thirds of a single plant per square foot, were strikingly different. The yields with 30, 4.0, 1.8, and 2/3 of a plant per square foot were, respectively, 42, 119, 131 and 99 bushel crates of marketable fruit per acre. Observations in fields of Dorsett, Fairfax, and other varieties in other strawberry sections indicated that the number of plants per given area is the chief, though not the sole, factor in determining adaptation.

Apparently in varieties such as Blakemore and Dorsett, where vigor of plant may be expressed by the production of many runners, yields may be increased by restricting the number of runner plants to the optimum number per square foot. Runner restriction, conserving as it does the soil nutrients and moisture, tends toward more crowns, more fruit buds and more fruit per plant.

In conclusion, the author emphasizes that potentially valuable new seedlings may be discarded and that new varieties have been and are being rejected simply because the plants have been grown in too dense stands. In testing seedlings or varieties a stand of 1 to 4 plants per square foot by July seems near the optimum. All later runners should be removed at frequent intervals. Culture should, of course, be such as to maintain in the greatest degree the vigor of the remaining plants.

GEORGE M. DARROW

U. S. DEPARTMENT OF AGRICULTURE

[1] Published with the approval of the director as Miscellaneous Paper No. 13, of the Pineapple Experiment Station, University of Hawaii.

[1] Geo. M. Darrow and Geo. F. Waldo, "The Practical Significance of Increasing the Daily Light Period of Winter for Strawberry Breeding," SCIENCE 69: 496–497, 1929; "Fruit-bud Formation in the Strawberry in Spring in Southeastern States," SCIENCE 72: 349–350, 1930.

THE RÔLE OF FUNGI IN THE DIET OF TERMITES

TERMITES of the species *Zootermopsis angusticollis* (Hagen) were fed individually and in groups on various fungus-containing and fungus-free diets.

When fed on rotten, fungus-containing Monterey pine, individually isolated termites, while suffering an initial loss in average dry weight and milligrams of nitrogen per termite, possibly due to a lag in adjustment to the condition of isolation, showed finally significant increase in weight and in nitrogen per termite and exhibited normal appearance and activity. Individually isolated termites on sound, fungus-free Monterey pine, on the other hand, showed an even greater initial loss in weight and nitrogen per termite and failed to make any significant gain in weight or nitrogen during the course of the experiment. They were sluggish in activity, abnormal in appearance, and those which died showed a reduced intestinal protozoan fauna.

Termites kept in groups on rotten, fungus-containing Douglas fir also showed better growth than those on sound, fungus-free Douglas fir, as evidenced by the greater increase in average dry weight per termite and the more rapid passage through successive instars of the termites on rotten wood. On rotten wood the termites were healthy and exhibited apparently normal viability, while on fungus-free wood there was high mortality during the second week of the experiment, cannibalistic feeding was excessive, and the increase in weight and nitrogen of surviving individuals was accomplished at the expense of the group as a whole.

Termites fed on sound Douglas fir on which there was a recent, superficial growth of the fungus *Trichoderma lignorum* (Tode) Harz showed good viability at a time when mortality was high on fungus-free, sound wood. Viability was good on sound Monterey pine, also, when fungi introduced by the termites were allowed to grow on the wood. In the latter case, it is significant that increase in average weight of termites occurred only after a visible growth of fungi had developed on the wood.

Rotten Douglas fir, however, proved to be a better diet for the termites than the wood which had only the superficial growth of *Trichoderma lignorum*. This was shown by the greater increase in average weight per termite and by the maintenance of higher group weight by termites on the rotten wood. Other fungi present in the rotten wood may have had greater nutritive value or more favorable enzymatic action on the wood than *T. lignorum*. Furthermore, it seems probable that the extensive chemical changes brought about in wood through the actual production of rot are important in preparing the wood to be a suitable diet for *Zootermopsis*.

Individually isolated termites when fed on fungus-free filter paper failed to make significant gain in weight. Termites kept together in groups on fungus-free filter paper showed greater decrease in group weight, higher mortality and less increase in average weight per termite than did those on their natural diet of rotten, fungus-containing wood. These results are in agreement with the observation by Cook and Scott (1933)[1] that termites are unable to live and grow normally on a diet of purified cellulose.

During the course of these feeding experiments better growth and higher viability have been observed among termites on fungus-containing wood than on fungus-free wood. It is evident, then, that fungi play an essential rôle in the natural diet of *Zootermopsis angusticollis*. The fungi offer a source of proteins. They probably supply vitamins which are essential to the normal growth and development of termites. Through the secretion of extracellular enzymes they may render the wood itself more nutritious. It is not known what effect the fungi may have on harmful extractives in the wood. On fungus-free, sound wood mortality of termites was even higher during the early part of the experimental period than on the more deficient diet of filter paper, while on sound wood on which a growth of fungus had developed viability was good. Whether the termites survived because they were better nourished or because the fungi had rendered some toxic factor in the wood harmless or because of both conditions is uncertain. It is certain, however, that the differential factor was the presence of the fungus.

ESTHER C. HENDEE
UNIVERSITY OF CALIFORNIA

SCIENTIFIC APPARATUS AND LABORATORY METHODS

PHYSIOLOGICAL MEDIA FOR FRESH-WATER AND MARINE PROTOZOA

THE cultivation of Protozoa for investigation involves principally three factors: medium, food and bacteria. Bacteria play a very important part when an organic medium is used, but their effect may be eliminated, or practically eliminated, if the medium is an inorganic one. The question of food is comparatively simple, because the food of Protozoa is in most cases not so specific. Any nutritive material

[1] S. F. Cook and K. G. Scott, "The Nutritional Requirements of *Zootermopsis* (*Termopsis*) *angusticollis*," *Jour. Cell. Comp. Physiol.*, 4: 95–110, 1933.

admissible to the feeding apparatus of the organism concerned is usually satisfactory. The most important factor is, however, the medium. On account of the selective-permeability of the cell membrane, the constitution and changes of the medium have immediate and direct influence on the life processes of the organism.

The writer has for a long time devoted himself to the finding of inorganic physiological media for his investigations on various unicellular forms, and has been able to develop two media, one for fresh-water and the other for marine Protozoa. The formulae of these media are as follows:

Medium A for Fresh-water Forms

$CaCl_2$	0.0008 N	
$NaNO_3$	0.0003 N	
$MgSO_4$	0.0002 N	
K_2HPO_4	0.0001 N	
KH_2PO_4	0.0001 N	
NH_4NO_3	0.0008 N	(for green forms only)

Medium B for Marine Forms

NaCl	0.1335 N	
$CaCl_2$	0.0112 N	
KCl	0.0084 N	
$NaNO_3$	0.0055 N	
$NaHCO_3$	0.0048 N	
$MgSO_4$	0.0040 N	
KH_2PO_4	0.0005 N	
Na_2SiO_3	trace	
NH_4NO_3	0.0125 N	(for green forms only)
$FeCl_3$	trace	(for green forms only)

In developing Medium A, extensive experimental work was done on Pleurotricha and Chlorogonium, which is also used as food for the former. In developing Medium B, experiments were performed with Kerenopsis and Dunaliella, which also serves as food for Kerenopsis. For other organisms, the total salt concentration and the hydrogen-ion concentration of both media may be slightly modified.

The working basis in formulating Medium A are: (1) The chemical analysis of fresh water; (2) the toxicity and antagonism of salts; (3) the buffering reaction of salts.

The formula of Medium B is based for anions on the chemical analysis of the salt content of the blood of certain marine organisms and for cations on the buffering properties of salts. In case of green forms, the chemical requirements for photosynthesis have also been taken into consideration.

These media are less toxic than natural fresh water or sea water and many other physiological media tested. They are satisfactory for most unicellular organisms the writer has tried to cultivate, but they are fatal to a few others. With frequent transferring to fresh media, organisms grow very well. By using these media for experimentation, surprisingly uniform results are obtained. In case of Pleurotricha and Kerenopsis, variation in size and fission rate are extremely small. Rhythmic variation in fission rate, such as that obtained by Jennings and others on Paramecium, has not been found.

Amos B. K. Penn

Kaiser Wilhelm-Institut für Biologie
Berlin-Dahlem, Germany

MICRO-METHODS FOR THE DETECTION OF PROTEASES AND AMYLASES

During the past two years the authors have been engaged in independent investigations of the digestive enzymes of amphibian embryos (F. D.) and of spiders (G. E. P.), respectively. The results of these investigations will be published separately elsewhere but we wish jointly to record two simple methods which proved convenient for the detection of proteases and amylases, respectively, when extremely small amounts of the extract or fluid to be tested were available. The method used for proteolytic enzymes is similar in principle to the more accurate quantitative method suggested by Gates;[1] the method used for amylases is based on that described by Bond,[2] but instead of using a thick layer of starch suspension in agar in the bacteriological manner a very thin dry film is substituted.

Proteases

A drop of the fluid or extract to be tested is mixed with several drops of an appropriate buffer solution; a drop of the resultant mixture is withdrawn and placed on the gelatin surface of an unexposed Eastman lantern slide plate which has been previously cleared in 20 per cent. sodium thiosulfate, thoroughly washed and dried. The slide should be placed in a moist chamber or otherwise protected from evaporation during the period of digestion. If enough of the original sample is available, it is convenient to run a series of drops at different pH values so that the approximate pH range of the enzyme is determined in the first experiment. The slide may be allowed to stand at room temperature if this does not exceed 20° C.; at temperatures of about 26° C. control drops of buffer solution dissolve the gelatin in the acid range, while at 30° C. the buffers dissolve the gelatin throughout the pH range used. In warm weather it is therefore necessary to perform the experiment in a thermostat. Gilman and Cowgill[3] used Gates's

[1] F. L. Gates, *Proc. Soc. Exp. Biol. Med.*, 24: 936, 1926–27.

[2] R. M. Bond, *Bull.* Bingham Oceanographic Coll., Yale Univ., 4: art. 4, p. 1, 1933.

[3] A. Gilman and G. R. Cowgill, *Jour. Biol. Chem.*, 88: 3, 743, 1930.

method at a temperature of 25° C.; presumably this is just below the critical temperature for solution of the gelatin on the Eastman commercial ortho film.

After a period of about two hours the plate is gently rinsed, fixed in 4 per cent. formalin to prevent further action of the adsorbed enzymes, washed and stained in either acid fuchsin or Delafield's hematoxylin. The former is preferable for the acid and the latter for the alkaline range, since contact with the buffer solutions alters the staining properties of the gelatin unless washing is unnecessarily prolonged for practical purposes. When digestion is complete a clear spot appears; with partial digestion a clear ring is commonly obtained, since action proceeds most rapidly around the edges of the drop. The method may be adapted for approximate quantitative purposes by placing drops on the plate at ten- or fifteen-minute intervals and choosing an arbitrary end point, such as the first appearance of a clear ring. Thus with just over a fifth of a cc of the original sample, by taking 0.01 cc portions and diluting each with 0.09 cc of various buffers, twenty different pH mixtures may be tested and both the pH range and the approximate pH optimum determined, since with care at least eight or perhaps nine small drops may be recovered from each. This procedure was devised to demonstrate the presence of both a pepsin and a trypsin in the abdominal digestive glands of spiders, the whole experiment involving 160 or more test spots being performed on a single extract from a single specimen.

The approximate sensitivity of the method was tested with four different dilutions of Merck's pancreatin, the end point as determined by the gelatin plate method being compared with that as determined by the digestion of casein. In the first case one drop of the sample was mixed with five drops of diluted glycocoll buffer at pH 9.0 (1 part of buffer to 3 parts of distilled water); in the second case 0.5 cc of the sample was added to 2.5 cc of 0.1 per cent. casein in diluted buffer as before. The digestion period was two hours.

Final dilution of enzyme solution	Gelatin plate	0.1 per cent. casein, tested with 1 per cent. acetic acid	
	24° C.	24° C.	39° C.
1: 3000	Clear	Clear	Clear
1: 6000	Half digested	Clear	Clear
1: 30,000	No detectable action	Cloudy	Faintly cloudy
1: 60,000	No detectable action	Cloudy	Cloudy

From these preliminary data it appears that the method is sufficiently sensitive for biological purposes. The thickness of the gelatin film on the Eastman lantern slide plates is about 15 microns; no doubt the sensitivity of the method could be greatly increased by the preparation of much thinner gelatin films. It was also found that the sensitivity of the plates is greatly decreased if they are stored for some months after clearing.

Amylases

A very thin starch film is prepared by mixing equal parts of hot solutions of 2 per cent. starch and 4 per cent. agar, the resultant hot mixture being poured on a previously heated glass plate and allowed to drain first from one side, then from the other. When dry this plate is used to test for amylases in the same manner as the gelatin plate for proteases. The test may be performed at room temperature or in a thermostat at about 39° C. At the end of the digestion period the plate is rinsed and stained in a solution of dilute iodine; if digestion is complete a clear spot appears, with partial digestion the spot is only partially cleared and often reddish from the erythrodextrins produced. It is necessary to use a drop of the buffer solution as control, since contact with the buffer slightly changes the appearance on staining and this may otherwise be mistaken for weak digestion. On account of the difficulty of preparing a perfectly uniform film, this method can not be used for quantitative work; several attempts were made to pour a uniform film by carefully levelling the plate and allowing it to dry in the horizontal position, but because of the tendency of the starch granules to form irregular clumps the results were unsatisfactory.

The approximate sensitivity of this method, which is very high, was determined with different dilutions of Merck's pancreatin; the end point as determined by the starch-agar plate method being compared with that as determined by the digestion of soluble starch. In the first case one drop of the test solution was mixed with five drops of diluted phosphate buffer at pH 6.75 (1 part of buffer, 1 part of 1 per cent. NaCl, 2 parts of distilled water); in the second case

Final dilution of enzyme solution	Starch-agar film		Soluble starch solution tested with dilute iodine	
	24° C.	39° C.	24° C.	39° C.
1: 12,000	Clear	Clear	Clear	Clear
1: 18,000	"	"	Reddish	"
1: 24,000	"	"	Blue	Purplish
1: 30,000	"	"	"	Blue
1: 60,000	"	"	"	"
1: 120,000	Almost clear	"	—	—
1: 240,000	Half cleared	"	—	—
1: 480,000	Very slight action	Almost clear	—	—
1: 600,000	"	"	—	—

0.5 cc of the test solution was added to 2.5 cc of soluble starch in diluted buffer solution with NaCl. The digestion period was two hours.

The above tests indicate that the method is at least twenty times as sensitive as the modification of Wolgemuth's method with which it was compared; it is capable of detecting at least one part in half a million of Merck's pancreatin.

Effect of Pyrex Glass

In connection with these experiments we should like to record an apparent inhibition of enzyme action obtained by extracting in pyrex glass. At a stage when the pancreas of *Amblystoma* embryos normally gives a strong amylase reaction, it was found that negative results were obtained if the extract was ground and kept in a pyrex mortar for some hours; similar effects were not obtained with ordinary soft glass nor with quartz. At the same stage the panereas gives a strong trypsin reaction whether pyrex is used or not, but at an earlier stage when the presence of trypsin can first be demonstrated, negative results were obtained when pyrex was used in the preparation of the extract. It thus appears that pyrex glass has a definitely inhibitory effect on both trypsin and amylase.

Grace E. Pickford
Frances Dorris

Osborn Zoological Laboratory
Yale University

SPECIAL ARTICLES

OBSERVATIONS ON FUNCTIONAL INTERRELATIONSHIP BETWEEN THE ADRENAL AND PARATHYROID GLANDS

Earlier concepts of functional interrelations between the endocrine organs were based largely upon hypothetical assumptions. More recently, however, reliable experimental evidence has been accumulating to prove specific, more or less complex, functional interdependence of certain endocrine glands. While in no instance does the evidence warrant final conclusion or definite functional interpretation, in many cases it points the way to further investigation and to a better understanding of some phenomena observed in experimental animals.

In the case of the adrenal gland so little is known at present, in spite of the voluminous literature, that functional interpretations from experimental evidences should be made with caution. It is not the purpose of this communication to attempt to prove a definite correlation of function between the adrenal and parathyroid glands. Nevertheless, there are some experimental results that suggest very strongly that such a correlation exists. These have opened avenues for further investigation which is in progress.

Rogoff and Stewart[1] observed that in animals deprived of their adrenal glands symptoms commonly develop which are also seen associated with disturbances in calcium metabolism. Muscular twitching, spasms and tetanic convulsions often occur. This observation led us to study the calcium content of the blood in adrenalectomized dogs, with the very interesting results showing a decided hypercalcemia in most of the animals.[2]

In our previous studies on adrenalectomized dogs[1] a striking picture in the alimentary canal was revealed at autopsy. Profound congestion of the mucosa of the entire gastro-intestinal tract and severe hemorrhage into the intestine was commonly found. It is significant, in view of the present subject, that a similar picture was described by Collip and co-workers[3] as occurring in dogs following administration of excess of parathyroid hormone.

In the course of our investigations I have observed that animals deprived of both adrenal glands and those subjected to sub-acute or chronic adrenal cortical insufficiency (by sub-total ligations of adrenal blood vessels) show, at autopsy, a relatively high incidence of parathyroid enlargement. While this is quite obvious grossly it has not been possible, thus far, to detect any significant microscopic changes in the gland.

Recently, Schour and collaborators[4] have found very interesting disturbances in calcification of dentin in the rat incisor, following administration of parathyroid hormone. At Dr. Schour's suggestion we undertook to study the influence of removal of the adrenal glands. This investigation is still in progress, but the results thus far obtained show a remarkable resemblance between the changes which occur in teeth of white rats following administration of an excess of parathyroid hormone and those found after excision of the adrenal glands.

These significant observations indicate an accumulation of experimental evidence which supports the view that a functional correlation exists between the adrenal and parathyroid glands. Whether the cortex

[1] Rogoff and Stewart, *Am. Jour. Physiol.*, 78: 683, 1926.

[2] Rogoff and Stewart, *Am. Jour. Physiol.*, 86: 25, 1928.

[3] Collip, *Am. Jour. Physiol.*, 76: 472, 1926; Collip, Clark and Scott, *Jour. Biol. Chem.*, 63: 439, 1925.

[4] Schour, Tweedy and McJunkin, *Am. Jour. Path.*, 10: 321, 1934.

or medulla of the adrenal (or both) are concerned can not be known from the available information. Among the animals that were subjected to vascular ligations there were some in which only the cortex degenerated, the medulla remaining intact. Whether or not functional integrity of the adrenal medulla may be altered yet present a normal appearance histologically is not known. However, the studies that are in progress may yield more definite information concerning the part played by the cortex or the medulla in the apparent interrelationship between the adrenal and parathyroid glands.

J. M. ROGOFF

CLEVELAND, OHIO

HISTOLOGICAL CHANGES IN THE BONE MARROW OF THE DOG FOLLOWING AMIDOPYRINE ADMINISTRATION

THE suggestion that amidopyrine administration is causative of acute agranulocytosis of human beings has been advanced by Kracke,[1] Madison and Squiers,[2] Watkins,[3] Sturgis[4] and others. Attempts to cause granulopenia by administering amidopyrine to animals have not been attended by consistent results. Even the prolonged use of relatively large amounts of the drug has, in many instances, failed to cause perceptible evidence of disturbed granulopoiesis. From experiments of this type grave doubt has been cast upon the etiologic rôle of amidopyrine in acute granulopenia in man.

Experiments involving the oral administration of amidopyrine to dogs have been made. A 5 per cent. solution in water (Metz and Company, lot 1433) was employed and 0.3 gram per kilogram of the drug was given daily by stomach tube.

In a series of sixteen animals studied no instance of marked decrease of circulating granulocytes was encountered, although treatment was continued for four weeks or more. Erythropenia of varying degree occurred.

Histological study of the femoral bone marrows of the treated animals, however, revealed striking changes, which gave evidence that the drug does affect the formation of granulocytes, even though not to a degree which is reflected in a materially decreased number of granular leukocytes in the circulating blood. A well-defined suppression of maturation of the hematopoietic elements occurs. Granulocytes are decreased in numbers or almost completely absent. The number of young, relatively undifferentiated cells is increased. Many erythroblasts and myeloblasts are present, as are cells of an even more primitive type; more adult forms are rare. In certain more advanced cases the orderly arrangement of the bone marrow structure into hematopoietic islands has been disturbed.

From the observations reported it appears that amidopyrine orally administered may exert a toxic effect upon the bone marrow, with little or no evidence of the fact in the circulating granular elements of the blood.

D. K. MILLER

THE ROCKEFELLER INSTITUTE,
NEW YORK, N. Y.

INSECTICIDALLY INDUCED IMMUNITY IN PLANTS TO SUCKING INSECTS

THE word immunity has been used in different ways and given various meanings by many workers. A recent article by Kenneth S. Chester[1] summarizes what is known in this field regarding plants and he defines immunity in plants as "the capability of withstanding infection acquired by the host either through the introduction of protective chemical substances of biological origin (passive) or through the elaboration of such protective substances in the host as a result of stimulation by the parasite." He states further: "It must be understood that the same principles as apply to the host-parasite relationship apply also to the relation between two symbionts or between a plant and introduced substances of a stimulative nature such as toxins or proteins which if not counteracted or inactivated would have a deleterious effect upon the plant."

Insecticides have been considered until very recently as materials which contained physical or chemical properties which produced toxic effects upon insects directly. It has been a common belief that in order to kill insects which obtain their food by sucking plant juices it is necessary to use insecticides which are known as "contact" materials and which have a direct insecticidal action upon the insect by the liberation of gases or other corrosive and penetrative effect upon the body of the insect. Such materials as nicotine sulfate and pyrethrum are known to produce toxic effects in this way. The plant has not been considered as a factor in insect control and has been given consideration only as it might be injured by chemical materials which were applied in attempting to control insects.

In 1926 experiments were undertaken to control the potato leafhopper (*Empoasca fabae* Harris) on bean and potato. Field experiments soon indicated that certain materials when applied to these plants in

[1] R. R. Kracke and F. T. Parker, *Jour. Lab. and Clin. Med.*, 19: 799, 1934.

[2] F. W. Madison and T. L. Squier, *Jour. Amer. Med. Asso.*, 102: 755, 1934.

[3] C. H. Watkins, *Proc. Staff Meet, Mayo Clinic*, 8: 713, 1933.

[4] C. C. Sturgis, *Proc. Asso. Am. Phys.*, May, 1934.

[1] *Quart. Rev. Biol.*, 8: 131, June, 1933.

e field gave no immediate results as toxic agents nd had no immediate effect upon the reduction of ese populations, but in the course of three to five ys after their application they reduced these popu-tions remarkably, causing motor paralysis of the sects and death. The effectiveness of these materials ntinued as the eggs in the plant tissues continued hatch over a period of several days and the young afhoppers, upon hatching, began to feed. A series f experiments then carried out by special techniques owed conclusively that these materials had no effect on the insects directly. But if they were applied the plant and the insects were then placed upon e treated plant, from a few hours to several days fterward, and were permitted to feed, these insects ould die in the manner mentioned above. With the aterials used only local areas of the plant were ffected in this manner and the plant system as a hole was not affected unless the plant foliage was vered with these materials. This apparently is in eeping with the factor of immunity in plants in eneral, since the cell is the seat of immunity and e system is usually not affected because of the sence of a circulatory system such as we find in imals.

This immunity effect or plant conditioning was first oduced by Bordeaux mixtures and other copper mpounds and was reported in 1929[2] and 1930.[3] At is time the writer referred to this condition as a sidual toxicity effect. More recently a similar type induced immunity in plants has been produced by rious sulfur materials. The apparent killing effect oduced upon the insect is the same as in the case copper compounds, although the effect upon the ant may be entirely different in case of these two aterials.

The results obtained with sulfur were first reported[4] 1933 when Dr. N. F. Howard, speaking before the hio Horticultural Society, cited the work which had en carried on during the preceding season (1932) the author, under his direction. A more complete port[5] was made by Dr. Howard and the author in nuary, 1934. More recently it has been found at practically all types of sulfurs will produce this fect in varying degrees upon these plants, although e elemental sulfur materials and those forms in hich the sulfur is not changed chemically by physi-l and chemical processes have given the best results. or instance, dusting sulfur, "dry mix," dry wettable d under some conditions flotation sulfur, will give tter results than liquid lime sulfur and colloidal sulfur when used to control the potato leafhopper on bean plants.

A recent article by List and Daniels,[6] of Colorado, reports a similar control of the potato psyllid upon potato and a similar residual effect upon the potato plant as that which has previously been produced by the writer with both Bordeaux mixture and sulfur materials on potato and bean.

The psyllid is a sucking insect closely related to the potato leafhopper and apparently is affected in the same manner by inducing immunity in the plant by chemical treatments.

Although insoluble when placed upon the plant tissue, these materials in some way either cause the plant to produce abnormal quantities of a toxic material which may possibly be produced normally by the plant only in minute quantities, or the chemical effect upon the plant may be direct by causing the character of the sap to change remarkably and the general rate of metabolism to change by the presence of extremely small amounts of the insecticide which has been absorbed in some form by the plant. Experimental work has given evidence of both possibilities.

Materials of this type can scarcely be classified as contact insecticides in the same manner as those materials which kill the insect by direct effect upon the insect's body. It seems necessary, therefore, to classify insecticides which affect insects of this type in two distinct groups: First, those which we have previously designated as contact insecticides and whose toxicity value refers to the direct insecticidal action upon the insect through contact; and, second, those which might be said to have a residual toxicity value which is attributed to an indirect effect since the toxicity is accomplished by a conditioning or partial conditioning of the plant (accessory to a certain possible inherent partial immunity) to produce a killing effect upon the insect.

Such a principle of toxic effect or insecticidal relationship—that of working through the plant and producing induced insecticidal immunity in the plant—has not received much positive support or serious consideration until this recent work of the past eight years has demonstrated conclusively these results.

DWIGHT M. DELONG

OHIO STATE UNIVERSITY

PHYSICAL RELATIONSHIPS BETWEEN MARSH AREAS AND LAKE LEVELS

IT seems to be quite a common assumption that receding lake levels are due to deforestation and cycle changes in precipitation. Similarly, marsh levels are usually supposed to be dependent upon the levels of adjacent bodies of water and streams. The writer is

[2] *Jour. Econ. Ent.*, 22: 345, April, 1929.
[3] *Jour. Econ. Ent.*, 23: 383, April, 1930.
[4] Proceedings of the Ohio Vegetable Growers Associa-n, p. 141, March, 1933.
[5] *Florida Grower*, 42: 8, 1934.
[6] SCIENCE, n. s., 79: 2039, January 26, 1934.

of the opinion that these assumptions are inadequate, and that there is a further and possibly more important relationship.

Six connecting lakes in Northern Wisconsin were studied for the purpose of determining the vertical fall of the lakes over a period of years. It was found that a low rate of recession had been going on over a period of about 32 years. Very probably this recession can be associated with the timbering operations which were complete about 1894. For the past eight years, however the rate of recession has grown at an alarming rate. Nearly 60 per cent. of the total recession seems to be associated with a time period not greater than eight years, or since 1926. This new rate was calculated as being about eight times as great as the rate effective up to that date. Inasmuch as there have been no great changes in forest cover since 1894, and the precipitation during the past decade has remained nearly constant, it was obvious that some new factor must have entered that lacked explanation.

The clew to this new factor was furnished by an analysis of many conversations with local people. In most cases the low lake levels were mentioned with dry marshes. Further conversation on the marsh conditions disclosed that a good many of the marshes had gone dry in 1926—or the same date that the new rate of recession had started on the lakes. From this the writer assumed that further work on the marsh areas might give some explanation of the lake levels. From the facts given, it is believed that a relationship can be demonstrated that has not been suggested before.

The gradual recession of the lakes over a period of 32 years has already been noted; suppose that the water on the marshes was declining at about the same rate. Then, in 1926, for the first time in recent history, the marshes froze over without surface water on them. This does not mean total dryness, but suggests that there was a minimum of surface water on the marshes. The following spring, the writer believes would bring radical changes to the area. The dry frozen marsh would require less energy to thaw out than the typical wet marsh of former years.

This energy change can be expressed in terms of the specific heats, and the latent heat of fusion of the substances involved.

Given: Specific heat of clay or sand 0.19
Specific heat of ice 0.50
Latent heat of fusion (ice) 80.00
Unit areas of wet and dry marsh.
Cd for depth of clay or sand.
Id for depth of ice.
Tx for temperature change from start of spring thaw until final melting of all ice.

Then the heat requirements for each marsh can be computed. The problem disregards the free water in the soil, which would tend to equalize in each type marsh.

Wet Marsh	*Dry Marsh*
$I_d \times T_x \times .50 = H_a$	$C_d \times T_x \times .19 = H_a$
$I_d \times 80 = H_b$	—
$C_d \times T_x \times .19 = H_c$	ΣH_2
ΣH_1	

Since ΣH_1 is much greater than ΣH_2, it follows that the wet marsh will require a great deal more heat to thaw out than the dry marsh. Since the total heat available each spring remains more or less constant, the effect of the ratio between ΣH_1 and ΣH_2 would be to demonstrate that the dry frozen marsh would thaw out much sooner in the season than the wet frozen similar areas.

If, then, the dry frozen marsh thaws out early, perhaps in two or three weeks of the early spring, does it not follow that the marsh will allow precipitation to seep vertically through the marsh into the deep water tables below? The wet frozen marsh, the writer believes, acts as a very effective barrier to vertical drainage, and forces the water laterally into the higher water tables, to stagnant pools, and finally into the brooks and streams that are tributary to the lakes.

This presentation does not allow for numerous variables that would enter into the problem. The writer believes, however, that if further detailed field study were done, there could be shown a high correlation between decreasing thaw periods for marshes and decreasing lake levels. It could also be demonstrated that the thaw period of a marsh is largely dependent upon the water content of the soil and the depth of surface water.

The implications of this theory, if acceptable, are numerous. The lakes tend to be dependent upon the marsh areas rather than the usual converse of this. The theory suggests that, if the marshes now dry could be frozen wet, lake levels could be raised. If marshes can be made to retain enough water over the summer months, it seems plausible that surface drainage could be restored. It would indicate to practical conservationists that it is fully as important to confine water on the surface of marshes as it is to retain water in lakes by means of dams. The theory may demonstrate enough dependence of lakes on marshes to change the economic use of marsh lands over a large area.

G. L. LINCOLN

UNIVERSITY OF WISCONSIN

BOOKS RECEIVED

RICE, VICTOR A. *Breeding and Improvement of Farm Animals.* Second edition. Pp. xiii + 516. 140 figures. McGraw-Hill. $4.00.

SMITH, DAVID E. *The Poetry of Mathematics and Other Essays.* Pp. 91. Illustrated. Scripta Mathematica, Yeshiva College, New York.

WEDDERBURN, J. H. M. *Lectures on Matrices.* Pp. viii + 200. American Mathematical Society.